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Report No. 13130

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT

(LOAN 3037-KO)

JUNE 9, 1994

Population and Human Resources Operations Division
Country Department I
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

Currency Unit - Korean Won (W)

US$1.00 = W680

(February, 1989)

GLOSSARY

ITC	-	Industrial Technology Center
KAIST	-	Korea Advanced Institute of Science and Technology
KAITECH	-	Korea Academy of Industrial Technology
KERI	-	Korea Electrotechnology Research Institute
KIT	-	Korea Institute of Technology
MOF	-	Ministry of Finance
MOST	-	Ministry of Science and Technology
MTI	-	Ministry of Trade and Industry
O&M	-	Operations and Maintenance
PCR	-	Project Completion Report
R&D	-	Research and Development
SMI	-	Small and Medium Industry
SMIPC	-	Small and Medium Industry Promotion Corporation
TIC	-	Test and Inspection Center

FISCAL YEAR

January 1 - December 31

ACADEMIC YEAR

March - February

THE WORLD BANK
Washington, D.C. 20433
U.S.A.

Office of Director-General
Operations Evaluation

June 9, 1994

MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

SUBJECT: Project Completion Report on Korea
Technology Advancement Project (Loan 3037-KO)

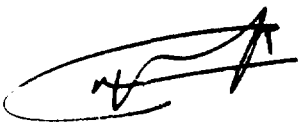
Attached is the Project Completion Report on Korea: Technology Advancement Project (Loan 3037-KO) prepared by the East Asia and Pacific Regional Office. Part II was prepared by the Borrower.

This was a simple project that provided construction and equipment to expand and upgrade three well established technical institutions. There was no technical assistance provided and no significant policy changes were sought.

The project highlights the appropriateness of providing only hardware in cases when the project institutions are well-developed and staff on both sides are competent and dedicated. The outcome is rated as fully satisfactory and promises to be sustainable. Institutional impact is rated as negligible but none was sought.

The PCR is of good quality.

No audit is planned.



Attachment

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3037-KO)

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PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(LOAN 3037 - KO)

PREFACE

This is the Project Completion Report (PCR) for the Technology Advancement Project in Korea for which Loan 3037-KO in the amount of US$16.4 million was approved on April 18, 1989. The loan was closed on schedule on December 31, 1992. The loan account books were kept open to honor applications received before April 30, 1993. The last transaction was made on June 18, 1993 against the full recovery of the initial deposit of USD400,000 advanced to the Special Account for one of the three project components, the Korea Electrotechnology Research Institute (KERI). The loan account was closed on June 18, 1993 with a total disbursement of US$16.3 million or 99.4% of the loan account.

The PCR was prepared in August/September, 1993 by EA1PH (Preface, Evaluation Summary, Parts I and III) and earlier by the Borrower (two of the three parts in Part II, the third part was not received from KERI until December 1993). The other two parts of Part II of the PCR were received in the Bank in March and June 1993 respectively. The Borrower's Ministry of Finance was requested to act as the coordinator for the three parts of Part II of the PCR.

Preparation of this PCR was started in May 1992 when a Bank mission requested the three institutions concerned to complete and return Bank-prepared pro-formas for the preparation of Part III of the PCR. The November 1992 Bank mission followed up with reminders on the pro-formas and the obligations of the borrower for submission of Part II of the PCR to the Bank. Based, inter alia, on the Staff Appraisal Report, the Loan Agreement dated May 31, 1987, supervision and progress reports, correspondence between the Bank and Borrower, and internal Bank memoranda and documents, Bank staff prepared the PCR in August/September 1983.

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(LOAN 3037 - KO)

EVALUATION SUMMARY

OBJECTIVES

(i) The objectives of the project were largely met (paras. 6 and 15). In general the broad aim of the project in improving the quality of education in a center of excellence in science and engineering education and enhancing the R&D capacity of selected institutions to provide better technical support to small and medium industry (SMI) was achieved. The impact of the project in all three institutions in the project was positive (paras. 15 and 16).

IMPLEMENTATION EXPERIENCE

(ii) Overall implementation experience was highly satisfactory. The project closed on schedule with no cost overrun. There were two physical components in the project - equipment financed by the loan and equipment-related civil works, which were financed by the Government. Equipment procurement was very close to target with disbursements of US$16.3 million out of loan proceeds of US$16.4 million. Thus actual disbursements were 99.4% of the loan amount. There was some delay in the implementation of civil works but this was resolved and did not affect the timely installation of equipment. Cooperation between the Bank and the project institutions was generally highly satisfactory and this can be attributed to strong start-up assistance from the Bank and the high quality of local implementation officials. Nevertheless, as the project progressed, there was less willingness on the part of one project institution to respond to the Bank's advice. However, this did not detract from the general success of project implementation.

RESULTS

(iii) The equipment procured under the project was relevant to the project's objectives. The quality of teaching has been strengthened at KIT and this institution has recently received international recognition of its standards. The ability of ITC to provide advice and technical services to SMI has been enhanced. Research programs have expanded, the range of tests undertaken for SMI clients has been broadened and the availability of results accelerated; revenue from service fees has increased substantially; and ITC (which has been renamed -see para. 14) has gained membership of an international certification agency. The R&D capacity of KERI has been strengthened and its capacity to support the development of SMI in the electrical industry has been enhanced.

SUSTAINABILITY

(iv) The project institutions are prestige institutions in Korea and receive strong support from their parent ministries (paras. 17-19). KIT has been integrated into KAIST, one of Korea's leading education and research institutes in science and technology. Thus it will continue to be well-financed and to recruit high quality faculty thereby ensuring the sustainability of the project's investment. ITC, which is the major industrial testing center, has also been given responsibility for training industrial technologists, thus giving the institution an even higher profile. KERI is the only electrotechnology research institute in Korea and services the vital electrical industry. The importance of both these institutes to Korea's technology development priorities will ensure continued strong support for them which in turn will reinforce the sustainability of the project's investments.

FINDINGS AND LESSONS LEARNED

(v) Project design was consistent with sectoral objectives and with previous Bank lending in technology development and science and technical education in Korea. Project design focused on hardware (equipment and civil works) and this was appropriate in view of the well-developed state of the project institutions. They were well-managed, staffed and financed. The need was for upgrading the teaching and research laboratories to permit the highly-qualified staff to work more effectively. Given the straightforward nature of project design and its successful implementation, there were no major lessons to be learned. Nevertheless, some insight can be gained. Strong initial start-up assistance from the Bank and the dedication of competent local staff enhanced the prospects for successful implementation. As the project progressed, one institution became less responsive to Bank advice and this situation could have been improved by greater face-to-face contact between Bank missions and local staff. Enthusiasm for writing Part II of the PCR was not high and in the case of one institution, its submission was received six months late.

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3037-KO)

PART I. PROJECT REVIEW FROM BANK'S PERSPECTIVE

A. Project Identity

- Project Name: Technology Advancement Project
- Loan No.: 3037-KO
- RVP Unit: East Asia and Pacific Region, Country Department I
- Country: Korea
- Sector: Education
- Subsector: Science and Technology

B. Project Background

1. Sector Development Objectives (At the time of project appraisal). In support of the Government's industrial restructuring policy, the objectives of the science and technology sector were to:

- develop and utilize technology to the fullest;
- gain continued improvements in productivity;
- expand high value added output which is technologically sophisticated, energy efficient and strongly export-oriented; and
- enhance the role of small and medium industry (SMI) for reducing industrial concentration and over-dependence on imported parts and materials;

In line with these priorities, the education sector's objectives were: to develop R&D capacity in both educational institutions and research institutes; to develop indigenous technology to overcome the increasing difficulty of importing technology from abroad; and to upgrade and restructure the skill mix requirements for meeting the demands of an increasingly technology-intensive industrial sector.

2. Policy Context. The above objectives are reflected in the Government's policy of strong commitment to technology promotion, increased assistance to SMI and continued improvement of the skill training system in response to advances in industrial development.

3. Research and Development. The growth of R&D in Korea underwent three major changes. First, the emphasis in the early stage on Government expenditures changed to the predominantly industry-funded contributions following the introduction, in the 1970s, of incentives for the private sector to expand R&D expenditures. Second, the overall growth of total R&D expenditures increased from 0.6% of GNP in 1980 to 2% in 1986 and is planned to reach 3% by 1995 and 5% by 2001. Third, the ratio of scientists and engineers (the basic human resource for R&D), is planned to increase from 13

per 10,000 population in 1986 to 30 per 10,000 by 2001. Further, the National Project scheme has been introduced to develop broader technological infrastructure in priority areas, strengthen linkage between industry and public R&D institutes and promote research on industry-initiated topics under joint ventures between SMI and contracted research institutes.

4. Science and Technology Education. In Korea, the development of education at secondary and higher levels has generally borne a close relationship to the country's economic development, especially in relation to industrial growth and restructuring. The shift from labor-intensive to capital-intensive and increasingly to technology-intensive industry has been accompanied by changes in the education system. Early emphasis was placed on vocational and technical education to produce skilled workers. This was followed by an expansion of junior technical colleges to train industrial technicians. As the economy moved towards more technology-intensive production, greater emphasis was placed on undergraduate science and engineering programs to produce professional scientists and engineers followed by priority for graduate education in these fields to supply key R&D personnel.

5. Small and Medium Industry. Industrial policy in the 1970s gave priority to the development of the large conglomerates. They grew rapidly while SMI activity declined in terms of a decreasing share of employment and value added. In the eighties, this trend was reversed and priority given to SMI expansion. This reversal was in response to the need to become more self-sufficient in the manufacture of parts and materials for large enterprises thereby reducing the import gap, to encourage regional development and to restructure SMI towards more technology-intensive production with strong emphasis on increasing export capacity.

C. Project Objectives and Description

6. The broad aim of the project was to strengthen the development of SMI in technology-intensive sectors, improve the quality of education in a center of excellence in science and engineering education and enhance the capacity of selected R&D institutions to provide technical support to SMI. More specifically, the project would help to improve the quality of science and engineering education and research at the Korea Institute of Technology (KIT), enhance the ability of the Industrial Technology Center (ITC) to provide advice and technical services to SMI and raise the research capability of the Korea Electrotechnology Research Institute (KERI) to support the development of SMI in the electrical industry.

7. The project financed specialized equipment, associated civil works and equipment-related consumable materials and O&M expenditures for KIT, ITC and KERI. More specifically, project inputs aimed to: increase experimental and practical work at KIT; strengthen basic R&D capacity, improve the focus on quality testing and inspection services to SMI, and propagation of low-cost automation techniques at ITC; and enhance R&D capacity at KERI to support the development of parts and materials for supply to major manufacturers from SMI in the electrical industry.

D. Project Design and Organization

8. The project was based on previous Bank support for technology development in Korea. At the time of preparation, the Bank had financed projects in electronics technology, industry promotion (including SMI) and research and development. The Bank had assisted technical and science education through six loans which complemented industrial development. Finally, the Bank had also provided general support for industrial development through a series of loans to local development banks and through an IFC loan to assist the commercialization of new technology. Based upon the experience of the Bank when the appraisal report was issued (March 1989), the conceptual framework for the project was appropriate, and it was clearly stated in the SAR. The project was designed over an eighteen month period, with inputs from the Government's central planning authorities, participating ministries/ institutions and Bank staff/consultants. Following the Bank's approval of the project, there were no significant changes in the project design.

9. The scope and scale of the project were appropriate since it continued support in those areas in which the Bank had previous experience while addressing the needs of the three national institutions which the Government had identified as requiring additional quality-improving investments. The development of these institutions (KIT, ITC and KERI) further encouraged the role of SMI in technological sectors by increasing the capacity of the institutions to provide technical support, and improving the quality of science and engineering education and research. The project design's focus on hardware (equipment and civil works) was also appropriate. The project institutions were found to be well-staffed by highly-qualified researchers, efficiently managed and well-financed. Their objectives were clearly stated and these were closely related to Korea's education and technology development priorities. Institutional weaknesses were in the physical aspects of laboratory provision and these were addressed under the project. Upgraded laboratories would increase the effectiveness of teaching and research staff.

10. The design of project management centered on the three institutions, each of which was responsible for the implementation of its part of the project, under the general budgetary oversight of the Ministry of Science and Technology (MOST). Two of the three excelled in their coordination with the Bank. The performance of the third institution, KERI, was somewhat less satisfactory and characterized by slower implementation and the very late submission for the PCR. Based on lessons learned from Ln. 2427-KO[1], the Bank requested that the Ministry of Finance (MOF) coordinate the preparation of Part II of the PCR. While KAIST, representing KIT, and KAITECH, representing ITC[2], submitted the requested information, MOF was unable to obtain similar information from KERI's staff. The latter was

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[1]In para. 8 of Part I of the PCR for Ln. 2427-KO dated May 17, 1991, it was stated that there was a need for a coordinator to oversee the preparation of the PCRs for projects dealing with more than one institution.

[2]For organizational changes affecting KIT and ITC, see para. 14.

received only after excessive delay and became available after the PCR was in final draft form.

E. Project Implementation

11. Comparison of "Planned" versus "Actually Performed" in Project Implementation. There were only two physical components in the project. One was civil works which was financed by the Government; the other was equipment which was financed by loan proceeds. Equipment is dealt with first. For KAITECH, procurement of 109 items of equipment was planned with an estimated cost of $11.5 million, exceeding the loan allocation to KAITECH ($7.0 million) by about $4.5 million. KAITECH selected 72 items of priority for procurement and the estimated cost was $7.4 million. The "Actually Performed" figure was 72 items and the contract cost was $6.97 million. Therefore there was little difference between "Planned" and "Actually Performed". For KAIST, 260 items were planned whose estimated cost was equivalent to the estimated loan allocation of $5.4 million. Procurement of 248 items at a cost of $5.32 million was achieved. The difference was also minimal. KERI procured 45 items of equipment at a cost of $3.98 million, which was within KERI's loan allocation of $4.0 million. As a whole there was no cost overrun. Out of the total loan amount of $16.4 million, $16.3 million was spent on equipment. There was also no time overrun on equipment procurement, as evidenced by the on-schedule loan closing.

12. As for civil works, only partial information was received from the project institutions. From data received, it was difficult to compare "Planned" with "Actually Performed". The part of civil works for housing project-related equipment was only a part of the overall construction programs for these institutions. It was almost impossible to delineate those costs for housing project related equipment from the overall costs, and those areas in m^2 from the total area constructed. However, there was no problem in housing newly procured equipment. There was some time overrun on civil works, but the project was not adversely affected.

13. Project Risks. There were no major risks as seen during appraisal. No major problem occurred during implementation. The amount of loan cancellation was $96,244.79, or about 0.6% of total loan amount, and this can be regarded as negligible. A minor problem occurred near the Loan Closing Date, December 31, 1992. For a contract of about $180,000, the disbursement of which had to be completed after the Closing Date, the borrower requested an extension of the Closing Date. The request was denied (reference: letter from Chief, EAIPH to Director, Treasury Division, MOF, Korea, dated December 9, 1992). The disbursements were completed during the four month grace period. There was also no problem on compliance with covenants (Table 9), submission of audit reports including separate opinion on statement of expenditures (Table 9) and timely submission of progress reports (Annex 2).

14. There were no unforeseen factors which affected project implementation, and there were no actions or decisions taken which affected implementation negatively. Two changes of jurisdiction, one with KIT being merged into KAIST, the other with ITC being changed to the Test and Inspection

Center (TIC) of KAITECH, were unforeseen events, but neither produced any adverse effect.

F. Major Results of the Project

15. Project Objectives. The objectives of the project were met.

- The quality of science and engineering education and research at the Korea Institute of Technology (KIT, now the undergraduate branch of KAIST) has been improved. KIT has recently been evaluated by a U.S. evaluation institution (Accreditation Board for Engineering and Technology) and rated as equivalent to one of the top 30% of universities in the U.S.

- The ability of the Industrial Technology Center (ITC), (now the Test and Inspection Center of KAITECH) to provide advice and technical services to SMI has been enhanced. TIC of KAITECH has now become a member of an international certification agency, IECEE, with TIC test and certification reports recognized by all its member countries. Test reports to SMI can now be returned in 10 days as compared to one month before this project. Service fees for operations carried out on behalf of SMI have more than doubled during 1987-92, revenues for R&D operations have increased more than fivefold in the same period, while Government's budgetary contribution increased by only about 20% in the five years.

- The Bank completion mission's estimate on KERI, made without the benefit of its PCR submission, is that the equipment purchased with the loan proceeds has increased its research capacity. The loan financed 45 key pieces of research equipment, virtually all of which had been installed and were being used by KERI at the time the project closed. KERI's late submission contained very little detail, but is consistent with the above comment.

16. Impact of Project. The impact of the project is positive on all the three institutions, although information about KERI is somewhat inadequate. There is little to add for KERI due to lack of information, but for KIT and ITC, the assessment is as follows:

(a) KIT, now a part of KAIST

KIT was an undergraduate institution, originally established for catering to gifted students in science in Korea. KAIST is an elite graduate school in Korea. The second objective of KIT is to supply KAIST with top level intake from students with a strong background of science from the senior secondary level and also to provide a high quality engineering training at the undergraduate level. The high quality engineering training at KIT cannot be achieved without sound experimental work in laboratories and solid practical work in workshops. Well-equipped laboratories and workshops are prerequisites for the attainment of this goal. The 248 items of equipment for KIT are said to form the cornerstone of the laboratories and workshops and bridge the gap

between KIT and KAIST. The project's positive impact on KIT and KAIST is therefore clear.

(b) ITC, now the Test and Inspection Center of KAITECH

In addition to what has been stated in para. 15 above about ITC vis-a-vis SMI, the research capacity has also been enhanced. The number of research topics increased from 18 in 1987 to 31 in 1992. The number of reports published also increased from 6 out of the 18 topics, or 33%, in 1987 to 16 out of the 31 topics, or 52%, in 1992. Both quantity and quality have significantly improved. The scope of tests carried out at TIC of KAITECH has been broadened by eight new fields, including environmentally related chemical tests, through use of the new equipment procured from the loan proceeds. Calibration scope and range have been expanded. The reliability of data has also improved. Further, mutual recognition with foreign institutions has resulted with the elevation of TIC to international status.

G. Project Sustainability

17. The Government's continued dependence on KAIST for producing the highest level scientific and technological manpower and as a major research institute, assures the sustainability of this component. KAIST, which now includes KIT, is the only educational institution under the Ministry of Science and Technology (MOST). The strong support of MOST for the well-being of KAIST, one of Korea's most prestigious institutions, further guarantees that KAIST will not face adverse conditions, such as lack of budgetary provision. The high esteem that KAIST has enjoyed in the last two decades in Korea, will also ensure that it will continue to recruit high-quality faculty without difficulty.

18. KAITECH, which now includes TIC, is under the jurisdiction of the Ministry of Trade and Industry (MTI). MTI's strong support of KAITECH is evidenced by the recent scheme of delegating the responsibility of training industrial technologists to KAITECH in addition to duties for assisting SMI and performing test, inspection and certification services. The strong commitment of the Korean Government to trade and industry and through MTI to KAITECH assures that this component, TIC of KAITECH, will be sustained in the future.

19. KERI under the jurisdiction of MOST is the only electrotechnology research institute in Korea. It is firmly believed that there is no sustainability problem with KERI. It services SMI in the electrical engineering industry in Korea, which is a priority field in the country's long-term technology-intensive development.

H. Bank's Performance During Project Cycle

20. Major Strengths and Weaknesses. Bank's performance on this project was in general satisfactory. The time spent on the early part of the project cycle, from identification at the end of CY87 to loan signing in early CY89, is below average. The staff input during this period (33.5 staff weeks) is also low and reflects the strong cooperation the Bank received from highly

competent local officials. Bank staff contribution during implementation was also satisfactory in providing timely assistance on how to avoid procurement delays and a possible extension of the Closing Date. This was achieved with total staff input for supervision of about 18 staff weeks (Table 10). The output/input ratio was therefore highly favorable. KERI's performance was, on balance, somewhat less satisfactory than that of the other components in terms of slower procurement and disbursement. Additional attention to KERI by supervision missions could have been beneficial.

21. Lessons Learned. Given the simplicity of project design and its successful implementation, there were no major lessons to be learned. A more modest lesson concerns the relative performance of the project institutions. While the performance of two components was commendable, the performance of the third (KERI) was less satisfactory. Procurement and disbursement for KERI were slower and there was no response to the Bank's last two supervision missions' requests for its cooperation on PCR work. (The submission for Part II of the PCR was finally received in December 1993). This problem could probably have been avoided, if more Bank staff time had been spent in the field focussing on KERI. Table 10 indicates that only 5.9 staff weeks were spent in the field for supervision during four fiscal years.

I. Borrower's Performance During Project Cycle

22. Major Strengths and Weaknesses. The performance of TIC was outstanding. Procurement of equipment was achieved ahead of schedule. Disbursement of the $7.0 million loan allocation for this component was complete, and there was no cancellation for the TIC component. Work on the PCR was also excellent. There was neither cost nor time overrun. All of this was achieved without any prior experience in Bank project implementation. Moreover, the cooperation with all Bank missions during the whole project cycle was impeccable. The performance of KAIST was also fully satisfactory. KAIST had prior experience with Bank project implementation and therefore only a minimal effort was required from Bank visiting missions to make this component a success. The weakness was with KERI. While the Bank missions' input to KERI was about the same as that for TIC, the result was less satisfactory. KERI was less responsive to advice offered by the Bank such as: the techniques to make up the time loss caused by the initial delays in equipment procurement; points related to the expiry dates of letters of credit; the steps to be taken for the speedy and timely recovery of funds in the Special Account before loan closing; and the need for completion of all activities before the Closing Date. However, KERI did not incur any cost or time overrun, and therefore overall performance of KERI should be considered satisfactory.

23. Lessons Learned. Again, there were no major lessons to be learned. However, one point worth noting is that institutions without prior experience with implementation of Bank projects can perform as well as those with such experience. This may have resulted from effective early start-up assistance from the Bank and the dedication of competent local implementation staff.

J. Project Relationships

24. Impact of Relationships on Project Implementation. The relationship between the Bank and the three institutions in this project was excellent at the start-up period of project implementation. This could have contributed to the lack of major problems during project implementation and to the excellent performance of an institution without prior experience with Bank projects. The relationship remained highly satisfactory with two institutions, throughout the implementation period but deteriorated with the third institution during the later months of project implementation. This was due in part to a certain lack of responsiveness by local staff to the Bank's advice and also to insufficient face-to-face contact in the field between local and Bank staff. Ultimately, the impact was minimal, no major implementation problems arose. A minor problem on the need for cooperation on PCR work, however, did arise. KERI did not produce a Part II report on schedule, in spite of numerous requests from Bank missions. Other relationships, such as those between the Bank and the two related ministries and those between component institutions and industry are satisfactory.

K. Consulting Services

25. There was no technical assistance in this project. There were also no studies or fellowships.

L. Project Documentation and Data

26. Adequacy of Staff Appraisal Report, Major Working Papers and the Legal Agreement. There is no evidence of any inadequacy in the Staff Appraisal Report, major working papers or the Legal Agreement.

II PROJECT REVIEW FROM BORROWER'S PERSPECTIVE
(BY KAITECH, June 1993)

1. General Remark

Part II of the project has been implemented as planned without any significant alteration, and KAITECH achieved most of the project objectives as described in the loan agreement and staff appraisal report.

2. Rename of Implementing Agency

In consequence of organizational change, ITC (Industrial Technology Center) was renamed KAITECH (Korea Academy of Industrial Technology) on October 12, 1989. There has been no virtual alteration in the functions and activities of ITC. This was formally notified to IBRD, and the Bank confirmed it.

3. Procurement

The procurement of project equipment has been made largely in cooperation with OSROK under ICB procedure. OSROK executed 10 bids for us during 1989-1991, and concluded contracts for 60 items or US$6.5 million. Other 12 contracts of US$0.5 million were made through bids conducted by KAITECH in 1992.

A few items had certain troubles at the time of installation or test operations but by now all have been cured and in normal operation.

4. Civil Works

KAITECH-TIC's new building has been constructed between August 1990 and February 1992. It is a 5 story building with a total floor space of 12,844m^2, and housed 56 items of project-financed equipment including EMC Anechoic Chamber. An additional building has also been built to house Explosion Proof Testing System. The remaining 15 items have been housed in existing buildings.

5. Disbursements

The revolving fund of US$800,000 maintained in the Special Account enabled KAITECH to efficiently settle payments. However, there were a few occasions that we had cash flow problems because of slow replenishment or reimbursement from IBRD.

Soon after the recovery of advance commences, towards the end of loan disbursements, it is inevitable for a borrower to use its own fund for timely payments, and then apply for reimbursement. If this had been more directly mentioned in para. 5.14 or somewhere in Disbursement Handbook, it might have helped many people.

6. Visiting Missions

Throughout the project period the visiting missions played a valuable role. Well experienced and understanding peculiar problems or situations, they did not spare effort to help implementing agencies in far details where letters can not reach while carrying out their own mission faithfully.

7. Effects of the Project

KAITECH's major objectives are to strengthen the foundation of industrial technology through R&D activities and to provide advice and technical services to small and medium industries. The loan project contributed to expand KAITECH's capacity and capability to carry out such objectives.

Please refer to DIRECT BENEFITS OF PROJECT attached to the pro-formas for Part III of PCR, for more details.

D I R E C T B E N E F I T S O F P R O J E C T

1. In general, KAITECH's capability to support SMI through its various activities including test and inspection services has grown up noticeably. This is suggested by the increase in revenue from both ordinary operations and R& D projects of Test and Inspection Center (TIC) which is the main beneficiary of the project within KAITECH. The change is apparent as follows.

Categories	FY 1987	FY 1992
Operations (service fees)	2,009	4,464 Won Million
R&D Projects	422	2,399
Government Contributions	3,008	3,873
Total Revenue	5,439	10,736

- With regard to R&D projects, please refer to the following:

	FY 1987	FY 1992
No. of research subjects	18	31
No. of reports -written	12	15
-published	6	16

2. The project contributed to enhance technical level and also to expand technical capacity of TIC. Selected topics are:

- TIC became a member of IECEE/CB Scheme, representing Korea, and its test reports are recognized in member countries. Although the objective items are limited to IEC-950 category, i.e., "information technical equipments including electrical business equipment", it is expected to expand the international test items to IEC-65 category for household electronics and IEC-335 category for household electrical appliances.

- With the new and powerful equipments TIC can perform tests better than before. Electro-magnetic field strength measurement, for example, was carried out only in an open site but now it can be done in the laboratory. For this and by virtue of the automatic measuring system, SMI can get test reports in 10 days or so instead of one month. EMI measurement range also expanded to 22 GHz from 1 Ghz. The reliability of data improved, and mutual recognition with foreign institutions became more active.

- TIC's calibration and measurement service to SMI has been the largest one in amount in the nation. It added two more technical fields of measurement recently, for TORQUE and IMPACT on material properties. Calibration ranges in many fields expanded; in case of radiation temperature measurement, the measurable temperature was 700° C to 1,700° C. But now lower temperatures between minus 20° C and 750° C can be measured also.

- The advance is seen also in chemical field of technology, that determination of toxic chemicals in air, water and working environments is available in its laboratories.

- The following fields should be added to the list of capacity that are expanded through the loan project.

  . Fatigues test / dynamic property test
  . Microstructure study / micro beam analysis
  . stress analysis
  . Magnetic components test
  . SMPC (switching mode power supply)
  . Explosion proof test
  . Non-destructive test
  . CNC machining

II. Review from Borrower's Perspective

(by KAIST, for KIT, June, 1993)

1. Expansion plan for the educational facilities

The Construction unit for KIT is as follows:

Classification		Building Unit	Reference
Land Space		369,858 m^2	
The Building Space	Educational Facilities	42,402 m^2	
	Support Facilities	16,840 m^2	
	Residential Facilities	39,131 m^2	
	Total	98,373 m^2	
Project Period		1983 ~1989	
Total Required Expenses		29,335 million won	

Due to the shortage of the educational facilities at KIT, KIT planned to construct the buildings of No. 5 and No. 6. However, this plan has been postponed by the merger of KAIST and KIT.
The financial resources for the construction of the buildings of No. 5 and No. 6 were converted to expand the buildings of National Science, Applied Engineering, and Mechanical Engineering.

- The unit for the expansion is as follows:

Buildings	Expansion Unit	Construction Expense	Construction Period
Natural Science	6,515 m^2	2,809 million won	'91.12.30~'92.12.24
Applied Engineering	1,197 m^2	450 "	"
Mechanical Engineering	2,650 m^2	994 "	"
Total	9,998 m^2	3,753 million won	

2. Loan process for the final outcome of the executive plan

- The loan processs

Annual Execution		'90	'91	'92	'93	Total
Plan	Volume	60 Item	100 Item	100 Item	-	260 Item
	Amount	1,200,000	2,100,000	2,100,000	-	5,400,000
Final out come	Volume	49 Item	88 Item	103 Item	8 Item	248 Item
	Amount	764,049.89	1,605,903.54	2,777,852.70	174,085.62	5,321,891.75

- Schedule for the processing plan

3. The Effect

KIT acquired a lot of laboratory work equipment with the help of both governmental support and IBRD loan in order to recover our prior shortage of educational facilities at KIT. With the history of years, KIT has been evaluated as one of the top 30% of all the universities in the U.S. by the ABET, an evaluation institution for engineering education in the U.S. In addition, the support from Korean government and the financial resources from IBRD loan had played an important role in the development of KIT. Especially, 248 laboratory work equipments, which couldn't be acquired by government's budget because ofo the high price, have been obtained by this project. To keep up with the most advanced equipments and to fill the shortage of our equipments, we need to increase our efforts in acquiring more equipments.

Project Review from Borrower's perspective

(Korea Electrotechnology Research Institute)

1. General Remark

Loan project has been satisfactorily carried out as scheduled except only one item of Cold Isostatic Press but KERI has now had significant facilities and equipment capabilities in the electric material field and good new R&D building.

2. Total Numbers of Items procured

Total Numbers of Items procured by loan has come up to 45 including Helium Liquefier System Set, Hot Isostatic Press and others.

3. Impact of Loan Project to SMI

As described in the Staff Appraisal Report written December 2. 1988, small and medium-sized industries in Korea have been playing very important parts to the growth of Korean economy for past 20 years. Accordingly Korean government, taking it into consideration that SMIs are the majority of Korean economy, has been making polices for the development and fostering of SMIs. From this point of view, all the facilities and equipments procured by loan project are now being utilized valuably for the research and development of electric materials, for example, functional materials, magnetic materials, superconducting materials and others, as well as for the testing of finished electric materials manufactured by local industries.

4. Civil Works

For the placement and installation of facilities and equipments, KERI has completed the construction of a new R&D building with the 2,640㎡ of 3 stories. The commence of construction of that building was made in July, 1991 and completion in April 1993.

5. Acknowledgement

KERI would like to express acknowledgement to many IBRD missions, inter alia, Mr. S.Z. Sung, procurement consultant and Mr. W. E. Rees, principal economist. In fact, if KERI had not got IBRD loan then, it was pretty difficult for KERI to secure the important and valuable facilities and equipments indispensable to the R&D and Testing sections.
In particular when KERI was in difficulties for execution, Mr. S. Z. Sung gave lots of advice and recommendation to Mr. Myung Pyo Hong and KERI has successfully achieved loan project
as scheduled without big blunder.
KERI would like to express again the hearty thanks to Mr. S. Z. Sung and Mr. W. E. Rees for their kindness and deep consideration.

PART III
STATISTICAL INFORMATION
A. RELATED BANK LOANS

Table 1: IBRD/IDA LOANS/CREDITS RELEVANT TO THE PROJECT

Loan/Credit Number Project Title	Year of Approval	Purpose of Project	Status	Comments
Cr 151-KO First Education Project	1969	Expansion of vocational high schools junior technical colleges and teach training	Completed 09/76	Successful project Satisfactorily implemented.
Ln 906/Cr 394-KO Second Education Project	1973	Improvement of vocational high schools, junior technical colleges and science, engineering and education colleges.	Completed 12/79	Implemented Substantially as planned. Line management evolved from Project Implementation Unit
Ln 1096-KO Third Education Project	1975	Expansion and quality improvement in vocational high schools, junior colleges and vocational training institutes. (VTIS)	Completed 11/81	Successfully implemented with growing experience and competence of local staff.
Ln 1474 Vocational Training Project	1977	Further expansion of VTIs, and expansion and improvement of instructor training.	Completed 06/83	PCR concluded that the project was well designed, implemented efficiently and judged it to be an excellent example to Bank/Borrower
Ln 1800-KO Sector Program on Higher Technical Education	1980	Improving junior technical colleges and colleges of engineering and management through supply of equipment, staff development, manpower planning, equipment maintenance and academic accreditation	Completed 02/86	A sector program successfully implemented
Ln 2427-KO Program for Science and Technology Education	1984	Raising the quality of science and technology education to standards required by a more skill-and knowledge-intensive industrial system through planned policy and institutional change.	Completed 06/89	A second sector program successfully implemented with all planned policy and institutional changes fully achieved.
Ln 3202-KO Second Technology Advancement Project	1990	Improving the research capacity of one leading graduate school in science and engineering and enhancing R and D capacities in the areas of Biotechnology, basic and industrial standards, and energy and resource utilization.	Effective on 11/08/90	Being implemented
Ln 3203-KO Universities Science and Technology Research Project	1990	Enhancing basic research programs in selected universities in priority fields in science and technology and improving science teacher training.	Effective on 11/08/90	Being implemented

Loan/Credit Number Project Title	Year of Approval	Purpose of Project	Status	Comments
La 3314-KO Vocational Education Project	1991	Upgrading the skill training provided in selected vocational high schools meeting the increasingly complex skill requirements of industry, commerce, agriculture and fisheries.	Effective on 09/03/91	Being implemented
La 3315-KO Third Technology Advancement Proje	1991	Improving the quality of research programs for developing advanced technologies, increasing opportunities for joint basic science research activities through common research facilities; and enhancing the development and application of industrial standards.	Effective on 09/03/91	Being implemented
La 3468-KO Science Education and Libraries Computerization Project	1992	Raising the quality of science programs in secondary schools and universities and establishing an inter library network system to enhance the access of information to students, faculty and researchers	Effective on 09/09/92	Being implemented
La 3469-KO Vocational Schools Development Project	1992	Continuing with the objectives in La 3314-KO to upgrade skill training in selected vocational high schools (VHS) and strengthening the VHS system through five studies in five agreed areas	Effective on 09/17/92	Being implemented

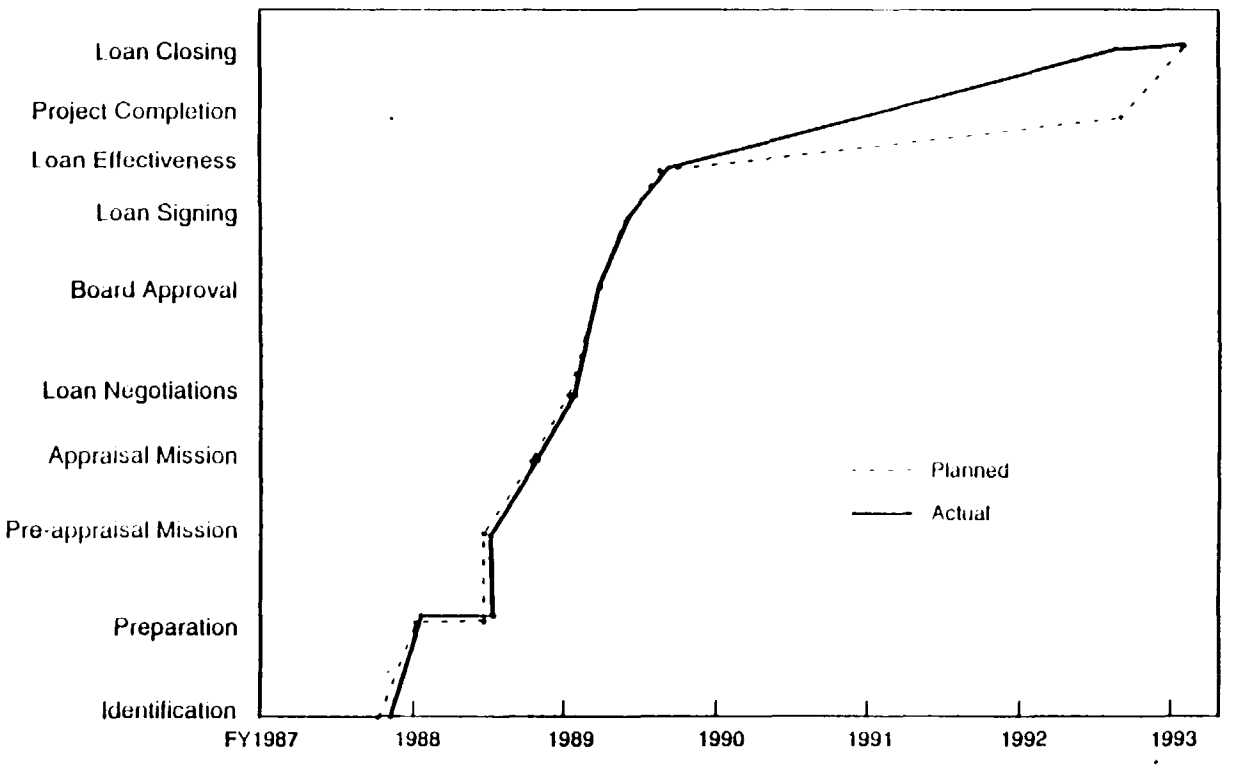
B. PROJECT TIMETABLE

Table 2: PLANNED, REVISED AND ACTUAL DATES OF PROJECT TIMETABLE

ITEM	PLANNED	ACTUAL
Identification Mission	November/December 1987	November/December 1987
Preparation by Government	January 1988 to June 1988	January 1988 to June 1988
Pre – Appraisal Mission	June 1988	June 1988
Appraisal Mission	October 1988	October 1988
Loan Negotiations	January 1989	January 1989
Board Approval	April 1989	April 1989
Loan Signature	May 1989	May 1989
Loan Effectiveness	August 1989	August 1989
Project Completion	June 1992	December 1992
Loan Closing /a	December 31, 1992	December 31, 1992

/a Date of closing of the loan account was June 18, 1992 with the cancellation of USD96,244.79, although the loan was closed on schedule on December 31, 1992.

Korea
Technology Advancement Project
Time Line of Planned and Actual Project Timetable



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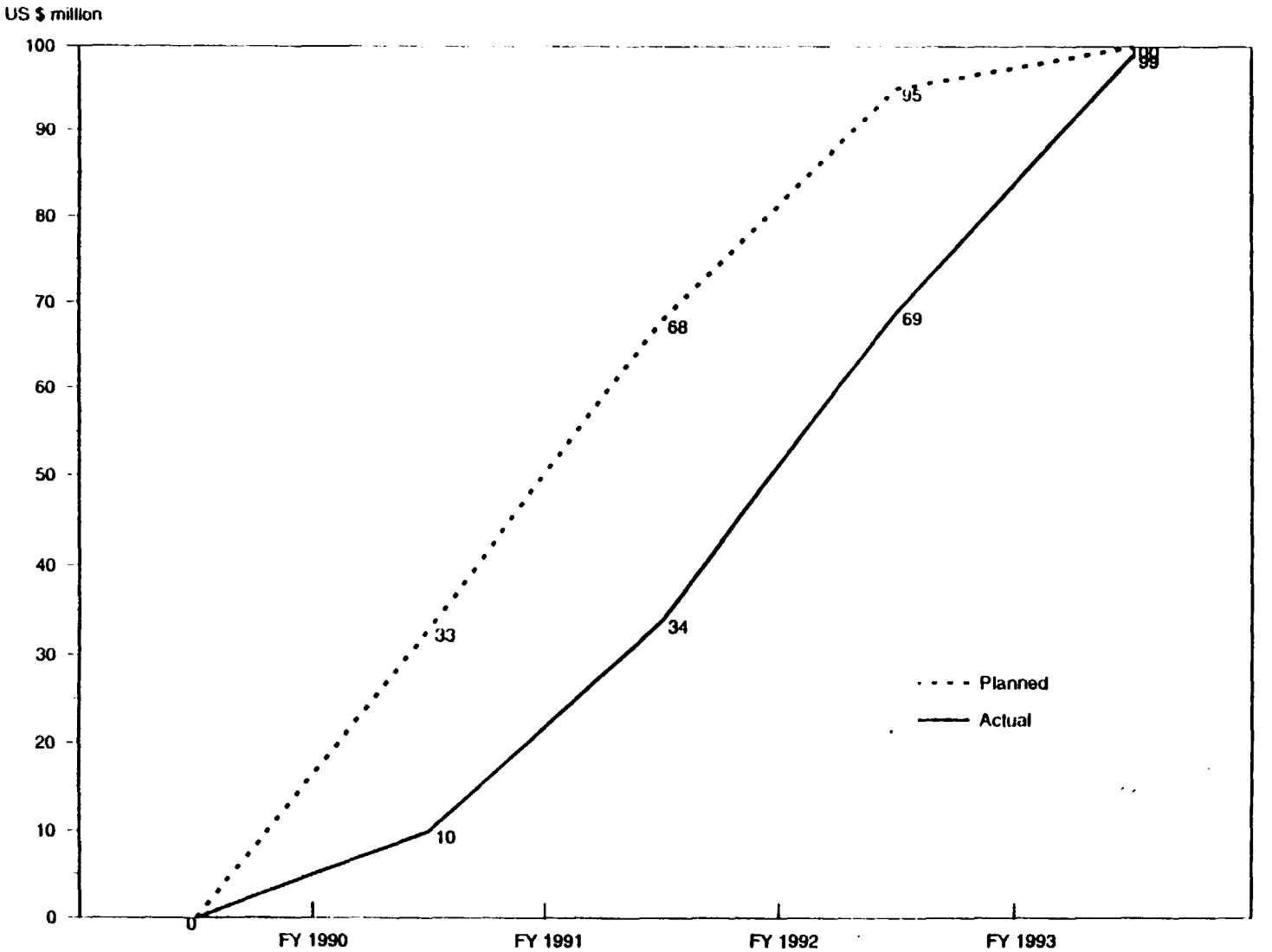
C. LOAN DISBURSEMENTS

Table 3: CUMULATIVE ESTIMATED AND ACTUAL DISBURSEMENTS

BANK FY	1990	1991	1992	1993
APPRAISAL ESTIMATES	5.4	11.2	15.6	16.4
ACTUAL	1.8	5.5	11.3	16.3
ACTUAL AS % OF ESTIMATE	33	49	73	99
DATE OF FINAL DISBURSEMENT	April 12, 1993			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$400,000 TO KERI	June 18, 1993			

Korea
Technology Advancement Project

Time Line of Planned and Actual Disbursement Schedule



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D. PROJECT IMPLEMENTATION

Table 4: PLANNED AND ACTUAL COMPLETION DATES OF COMPONENTS/a

Project Compotnents	Planned Completion Date	Actual Completion Date	Months of delay (or advance)	Percentage differences (--for advance)
Korea Academy of Industrial Technology (KAITECH)/b				
Civil Works	August 1991	February 1992	6	22%
Equipment	June 1992	December 1992	6	16%
Korea Advanced Institute of Science and Technology (KAIST)/b				
Equipment	June 1992	December 1992	6	16%
Korea Electrotechnology Research Institute (KERI)/c				
Civil Works	--	--	--	--
Equipment	June 1992	Decembe 1992	6	16%

/a There was no extension of Closing Date for this Loan.
/b Based on reports from KAITECH and KAIST.
/c Report from KERI has not been recieved.

B. PROJECT COST AND FINANCING

Table 5: PROJECT COSTS (US$ million)

COMPONENT	APPRAISAL ESTIMATE			ACTUAL COST			PERCENTAGE CHANGE OF TOTAL
	LOCAL	FOREIGN	TOTAL	LOCAL	FOREIGN	TOTAL	
KAITECH (ITC)	4.2	9.9	14.1	4.9	8.0	12.9	-8.5%
KAIST (KIT)	2.9	6.2	9.1	0.4	5.3	5.7	-37.4%
KERI /a	2.2	4.6	6.8	-	-	-	/b
TOTAL	9.3	20.7	30.0	-	-	-	-

/a Not available as KERI did not submit information as requested.

/b Similar to the other two components, Bank's estimate was that it was also a cost underrun.

Table 6: PROJECT FINANCING (US$ million)

SOURCE OF FUNDS	PLANNED (as in SAR)	FINAL	PERCENTAGE CHANGE OF TOTAL
IBRD Expenditure Categories			
Equipment	16.4	16.3	-0.6%
Domestic Financing			
KAITECH	4.9	5.6	14.3%
KAIST /a		–	–
KERI /b	–	–	–
Total	–	–	–

/a While KAIST has submitted information on civil works achieved and expenses incurred, the data could not be compared with SAR figures. Therefore the line could not be completed.

/b KERI did not submit information as requested.

Table 7: ALLOCATION OF LOAN PROCEEDS (US$)

	ORIGINAL ALLOCATION	ACTUAL DISBURSEMENTS /a
KAIST /b		
(1.) Equipment and materials for KIT under Part A of the Project.	5,400,000	5,321,890.97 /d
KAITECH /c		
(2.) Equipment and materials for ITC under Part B of the Project	7,000,000	7,000,000 /e
KERI		
(3.) Equipment and materials for KERI under Part C of the Project	4,000,0000	3,981,864.24 /f
Subtotal	16,400,000	16,303,755.21
Amount of Loan Cancelled		96,244.79

/a Based on memorandum from Marie Khoury, LOAAS to William E. Rees, EA1PH dated June 30, 1993.

/b The Korea Institute of Technology (KIT) has been merged into the Korea Advanced Institute of Science and Technology (KAIST).

/c The Industrial Technology Center (ITC) has become a part of Korea Academy of Industrial Technology (KAITECH).

/d No adjustment

/e KAITECH over disbursed from Special Account by $1,269.49 due to foreign exchange adjustments.

/f KERI over disbursed from Special Account by 2,496.01 due to foreign exchange adjustment. Total of /e and /f is $3,765.50 and this represents the undisbursed amount KERI from its Loan Account. When $3,755.50 is added to KERI's disbursement of $3,978,098.74 Actual disbursement from KERI should be $3,981,864.24.

F. PROJECT RESULTS

Table 8: DIRECT BENEFITS OF PROJECT

(a) KAITECH

(i) Increase of Revenue

Categories	Korean FY 1987 (before the Project)	FY 1992 (after the Project)
Operations (services fees)	2,009	4,464 millon won
R & D Projects	422	2,399 " "
Government Contributions	3,008	3,873 " "
Total Revenue	5,439	10,736 million won

Percentage increase in Revenue is: 97% (including Government Contribution) and 183% (excluding Government Contribution).

The Project helped the Testing and Inspection Centers (TIC) of KAITECH in increasing its revenue.

(ii) Increase of Research Work

	FY 1987	FY 1992	Percentage Increase
No. of research subjects	18	31	72%
No. of Published reports	6	16	167%

The Project helped increase both the quantity and quality of research work.

(iii) Institutional Benefit

TIC because a member of IECEE, an international agency on Certification of Electrical Equipment, as a result of higher level of equipment and higher standard and wider scope in testing, inspection and certification.

(b) KAIST

KIT acquired a lot of laboratory equipment with the help of both governmental support and the IBRD loan in order to overcome the prior shortage of educational facilities at KIT. KIT has been evaluated at a level equivalent to one of the top 30% of universities in the U.S. by the ABET, an evaluation institution for engineering education in the U.S. In addition, the support from the Korean government and the financial resources from the IBRD loan played an important role in the development of KIT. In particular, 248 items of laboratory equipment, which could not be financed locally because of current budgetary constraints, have been procured under the project.

(c) KERI

Forty-five items of equipment were procured and these are helping to strenghten KERI's capacity to carry out R&D activities in support of SMIs in the electrical industry.

G. STATUS OF LOAN COVENANTS

Table 9: COMPLIANCE WITH LOAN COVENANTS

Section No. in Loan Agreement	Para No. in SAR	Description	Status of Compliance and Deadline Dates, if applicable
4.01	3.15	Furnish to Bank annually Audit Reports including separate opinion on Statements of Expenditure and certified copies of financial statements	By June 30 of each year. In full compliance.
5.01	3.09	Manage each project components under supervision of qualified and experienced staff and with adequate numbers of competent supporting staff	In full compliance.

H. USE OF BANK RESOURCES

Table 10: STAFF INPUTS BY STAGE OF PROJECT CYCLE IN STAFF WEEKS

STAGE OF PROJECT CYCLE	PLANNED		FINAL	
	HQ	FIELD	HQ	FIELD
Through Appraisal	60	30	30.2	16.0
Appraisal–Negotiations	10	–	3.1	–
Negotiations–Loan Signing	2	–	0.2	–
Supervision	24.5	8	17.8	5.9
PCR	7	2	3.0	1.0
Others (project Admin)	1.5	–	1.5	–
Total	103	40	55.8	22.9

Table 11: MISSION DATA BY STAGES OF PROJECT

Mission	Month/Year	No. of Person/s	Staff Week in Field	Performance Status by Activity /b			
				F	M	I	G
Identification	11-12/87	2 (PE,TE)	6				
Preparation (by Govt)	1/88-6/88	--	--				
Pre-appraisal	6/88	2 (PE,TE)	4				
Appraisal	10/88	3 (PE,TE, PCA)	6				
Subtotal			16				
Supervision I	10-11/89	1(TE)	1.6	1	1	1	1
Supervision II	6-7/90	1 (TE)	0.8	2	1	1	1
Supervision III	2-3/91	1 (TE)	0.5	2	2	1	1
Supervision IV	10-11/91	2 (TE, ITS)	2.0	2	1	1	1
Supervision V	5-6/92	1 (TE)	0.5	2	1	1	1
Supervision VI	11-12/92	1 (TE)	0.5	1	1	1	1
	Subtotal		5.9	1.7	1.1	1.0	1.0
PCR	4/92 and 5/92	1 (TE)	1.0				
	Total		22.9				

/a PE = Principal Economist; TE = Technical Educator, PCA = Project Cost Analyst; ITS = Industrial Training Specialist

/b F = Financial; M = Managerial; I = Development Impact; G = Overall Status

ANNEX 1

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3037-KO)

PARTICIPANTS IN COMPLETION MISSION[1/]

World Bank

Sing-Zak Sung, Consultant, Technical Educator

Korea Advanced Institute of Science and Technology

Nam-koo Lee, International Affairs Section

Korea Academy of Industrial Technology

Paik Soo-hyun, Director General, Test and Inspection Center
Chun, Jung-woo Chief, Planning Section, Test and Inspection Center

1/ The completion mission was undertaken as part of the supervision mission for all Korean education and technology advancement projects in November 1992.

ANNEX 2

PROJECT COMPLETION REPORT

KOREA

TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3037-KO)

RECORD OF PROGRESS REPORTS SUBMITTED

1. Status Report (May-Oct. 1989) from Korea Academy of Industrial Technology, November 1989.

2. Status Report from Korea Institute of Technology, November 1989.

3. Progress Report from Korea Electrotechnology Research Institute, November 1989.

4. Report on the Progress Status of IBRD Loan Project Implementation from Korea Advanced Institute of Science and Technology of which Korea Institute of Technology is now a part, June 1990.

5. Status Report from Korea Academy of Industrial Technology, June 5, 1990.

6. Progress Report from Korea Electrotechnology Research Institute, June 19, 1990.

7. Report on the Progress and Status of IBRD Loan Project Implementation (for the period August 10, 1989 to February 15, 1991) from Korea Advanced Institute of Science and Technology, February 1991.

8. Report of the Progress and Status of IBRD Loan Project Implementation (for the period from June 20, 1990 through March 5, 1990) from Korea Electrotechnology Research Institute, March 6, 1991.

9. Progress Report (as of February 23, 1991) from Korea Academy of Industrial Technology (KAITECH, formerly Industrial Technology Center, ITC), February 23, 1991.

10. Report on the Progress and Status of IBRD Project Implementation (for the period May 31, 1989 to Oct. 15, 91) from Korea Advanced Institute of Science and Technology, October 15, 1991.

11. Status Report from Korea Academy of Industrial Technology (as of October 23, 1991), October 24, 1991.

12. Present Status of Loan Project (as of October 24, 1991) from Korea Electrotechnology Research Institute, October 24, 1991.

13. Report on the Progress and Status of IBRD Loan Project Implementation (for the period from August 10, 1990 to May 15, 1992) from Korea Advanced Institute of Science and Technology, May 22, 1992.

14. Status Report from Korea Academy of Industrial Technology (as of May 19, 1992), May 19, 1992.

15. Present Status of Loan Project (as of May 20, 1992) from Korea Electrotechnology Research Institute, May 20, 1992.

16. Report on the Progress and Status of IBRD Loan Project Implementation (for the period from August 10, 1989 to November 1, 1992) from Korea Advanced Institute of Science and Technology, November 4, 1992.

17. Status Report (as of November 12, 1992) from Korea Academy of Industrial Technology, November 12, 1992.

18. Present Status of Loan Project (as of November 15, 1992) from Korea Electrotechnology Research Institute, November 15, 1992.